



⑪ Publication number : **0 611 069 A1**

⑫

## EUROPEAN PATENT APPLICATION

⑰ Application number : **94300613.0**

⑤① Int. Cl.<sup>5</sup> : **A61F 5/01**

⑱ Date of filing : **27.01.94**

⑳ Priority : **12.02.93 US 17032**

④③ Date of publication of application :  
**17.08.94 Bulletin 94/33**

⑥④ Designated Contracting States :  
**AT BE CH DE DK ES FR GB GR IE IT LI LU MC  
NL PT SE**

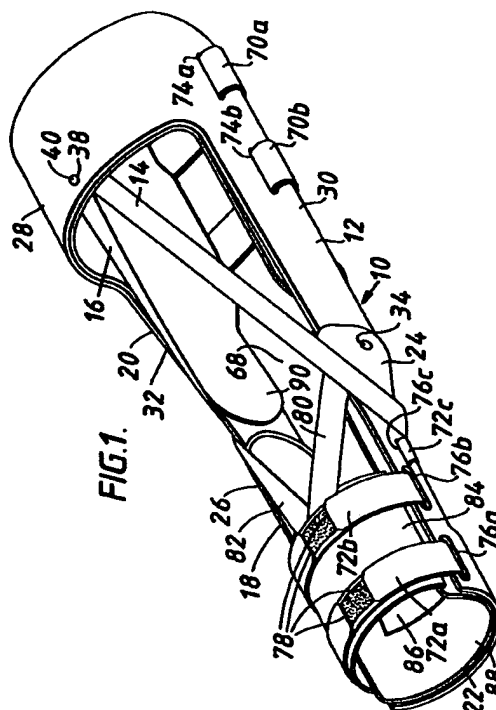
⑦① Applicant : **SMITH & NEPHEW DONJOY INC.**  
**2777 Loker Avenue West,**  
**Suite 100**  
**Carlsbad, CA 92008-6601 (US)**

⑦② Inventor : **Nebolon, Joseph F.**  
**13824 Recuerdo Drive**  
**Del Mar, California 92014 (US)**

⑦④ Representative : **Gilholm, Stephen Philip**  
**Corporate Patents Department**  
**Smith & Nephew Group Research Centre**  
**York Science Park**  
**Heslington York YO1 5DF (GB)**

⑤④ **Hinged orthopaedic brace having compliant support components.**

⑤⑦ An orthopaedic brace (10) for supporting a joint has a plurality of compliant support components, including a hinged shell (12) of stiffened elastic material and at least one supple support strap (14,16) engaging the brace at two points on opposite sides of the hinge to stabilise the weakened joint throughout its range of motion. The shell has a pair of cuffs (22,28) adapted to engage the body adjacent to the joint and connected to one another across a rotatable hinge (34,36) by arms (24,30,26,32) integrally extending from the cuffs. The support strap is adjustable in length enabling the user to modify the support strap tension, and consequently the degree of support the brace provides to the joint.



The present invention relates generally to orthopaedic braces, and more particularly to a hinged orthopaedic brace that is substantially free of any rigid support components, thus, having only compliant support components.

Orthopaedic braces are commonly employed on the body of a user to stabilise a skeletal joint that has been weakened by injury or other infirmity. Such braces are made up of a member of rigid support components that are dynamically linked together by one or more hinges to support the joint during user activity. The brace is positioned on the body such that the hinges traverse the joint being stabilised, while the rigid components are secured to the body at a plurality of contact points above and below the joint. Typical hinged orthopaedic brace constructions are disclosed in US Patents 4,633,867; 4,697,583; and 5,063,916.

The utility of conventional hinged orthopaedic braces is, however, diminished by a number of drawbacks. The rigid components of conventional braces are bulky and noncompliant, often rendering them uncomfortable for the everyday user and difficult to initially size and fit. Conventional braces pose additional problems for athletic users. Specifically, certain athletic competitions, such as soccer and rugby, have rules barring the use of braces with rigid protruding components because the components create a risk of injury to other players from contact therewith. Conventional braces can also be disadvantageous to the athletic user because the braces have an irregular surface which reduces the desired ability of the user to control balls or other objects impacting the surface and rebounding therefrom during athletic competitions.

Accordingly, it is an object of the present invention to provide an orthopaedic brace that overcomes the above-described drawbacks. In particular, it is an object of the present invention to provide a hinged orthopaedic brace that provides the user with a high degree of comfort while wearing the brace. It is also an object of the present invention to provide a hinged orthopaedic brace having compact components for ease of sizing and fitting. It is further an object of the present invention to provide a hinged orthopaedic brace having only compliant support components, ie. a hinged orthopaedic brace that is substantially free of any rigid support components, yet which provides for control and stability of the desired joint. It is another object of the present invention to provide a hinged orthopaedic brace that may be used in athletic competitions having rules barring braces with rigid support components. It is yet another object of the present invention to provide a hinged orthopaedic brace having a relatively even, flush surface that reduces the risk of injuries to others coming in contact therewith and that permits greater control of balls or other objects rebounding therefrom during athletic

competitions.

The present invention is an orthopaedic brace for supporting a joint throughout its range of motion when the brace is mounted about the joint on a limb of a user. The support components of the brace are a hinged shell formed from a compliant, yet stiffened, material that conforms to the contours of the limb and a pair of supple support straps engaging the shell at specific points thereon. The shell is configured to maintain a predetermined dynamic relationship between the support straps and the joint as the joint moves through its range of motion, thereby enabling the support straps to stabilise an injured or otherwise weakened joint. All of the support components of the brace are fully compliant and, thus, the brace is substantially free of any rigid support components.

Thus according to the invention we provide an orthopaedic brace substantially free of any rigid support components mountable on a leg for supporting a knee joint between the upper and lower leg, said brace comprising:

- a) a compliant shell comprising,
  - 1) an upper leg cuff conformingly positionable on the upper leg, and
  - 2) a lower leg cuff conformingly positionable on the lower leg;
- b) hinge means pivotally engaging said shell for rotating said upper leg cuff relative to said lower leg cuff about the knee joint; and
- c) a support strap engaging said brace at at least two engagement points, wherein a first engagement point on said brace is adjacent to the upper leg on a first side of the leg and a second engagement point on said brace is adjacent to the lower leg on a second side of the leg opposite the first side of the leg, such that said support strap extends laterally of medially from the first side of the upper leg across the knee joint to the second side of the lower leg.

The brace can be adapted to support any one of a number of joints on the limbs of the body, including the wrist, elbow and knee. In each case, the stiffened elastic shell comprises a proximal cuff and a distal cuff adapted to proximally and distally engage the limb about the joint, respectively, with the cuffs preferably positionable on opposite sides of the limb.

We also provide an orthopaedic brace substantially free of any rigid support components mountable on a limb for supporting a joint between the proximal and distal portions of the limb, said orthopaedic brace comprising:

- a) a compliant shell comprising,
  - 1) a proximal cuff conformingly positionable on the proximal portion of the limb;
  - 2) a distal cuff conformingly positionable on the distal portion of the limb;
- b) hinge means pivotally engaging said shell for rotating said proximal cuff relative to said distal

cuff about the joint; and

c) a support strap engaging said brace at at least two engagement points, wherein a first engagement point on said brace is adjacent to the proximal portion of the limb on a first side of the limb and a second engagement point on said brace is adjacent to the distal portion of the limb on a second side of the limb opposite the first side of the limb, such that said support strap extends laterally or medially from the first side of the limb across the joint to the second side of the limb.

The shell further comprises a lateral proximal arm and a medial proximal arm, each connected to the proximal cuff and extending therefrom in a distal direction generally longitudinal to the proximal portion of the limb. Additionally, the shell comprises a lateral distal arm and a medial distal arm, each connected to the distal cuff and extending therefrom in a proximal direction generally longitudinal to the distal portion of the limb.

The brace is provided with a hinge at the lateral and medial junctions of the proximal and distal arms adjacent to the joint which enables rotation of the proximal cuff about the joint relative to the distal cuff. In particular, the hinge comprises a lateral pin pivotally connecting the lateral proximal arm to the lateral distal arm, and a medial pin pivotally connecting the medial proximal arm to the medial distal arm.

Both support straps are anchored to the brace at a proximal engagement point and at a distal engagement point. In addition to being proximally or distally positioned, the engagement points are further either anteriorly or posteriorly positioned on opposite sides of the brace from one another. One support strap is a lateral support strap extending from the proximal engagement point around the lateral side of the joint to the distal engagement point, and the remaining support strap is a medial support strap extending from the proximal engagement point around the medial side of the joint to the distal engagement point.

The proximal and distal engagement points are preferably located at substantially central positions on the proximal and distal cuffs, respectively. The support straps are fully adjustable in length enabling the user to modify, as desired, the support strap tension, and consequently the degree of support the brace provides to the joint.

A plurality of proximal and distal shell retention straps are provided in engagement with the shell which enable closure of the brace around the limb. The shell retention straps are provided in engagement with the shell in a desired stable position on the limb about the joint. Guide straps are provided in attachment to the support straps and extend therefrom for connection to the shell. The guide straps function in conjunction with the shell to guide the support straps as the joint moves through its range of motion.

An orthopaedic brace substantially free of any

rigid support components mountable on a leg for supporting a knee joint between the upper and lower leg, said brace comprising:

a) a compliant shell comprising,

1) an upper leg cuff conformingly positionable on the anterior of the upper leg, and

2) a lower leg cuff conformingly positionable on the posterior of the lower leg;

b) hinge means pivotally engaging said shell for rotating said upper leg cuff relative to said lower leg cuff about the knee joint;

c) a first support strap engaging said shell at at least two engagement points, wherein a first engagement point is on said upper leg cuff and a second engagement point is on said lower leg cuff, such that said support strap extends laterally from the anterior of the upper leg across the knee joint to the posterior of the lower leg; and

d) a second support strap engaging said shell at said at least two engagement points, such that said second support strap extends medially from the anterior of the upper leg across the knee joint to the posterior of the lower leg.

The present invention will be further understood, both as to its structure and operation, from the accompanying drawings, taken in conjunction with the accompanying description, in which similar reference characters refer to similar parts.

Figure 1 is a frontal perspective view of an embodiment of the orthopaedic brace of the present invention adaptable to the knee joint or other body joints,

Figure 2 is a rear perspective view of the orthopaedic brace of Figure 1,

Figure 3 is a frontal perspective view of an alternate embodiment of the orthopaedic brace of the present invention adaptable to the knee joint or other body joints,

Figure 4 is an exploded frontal perspective view of the distal portion of the orthopaedic brace of Figure 1,

Figure 5 is a side elevational view of the orthopaedic brace of the present invention adapted as a knee brace in place on the leg of a user with the knee joint in an extended position,

Figure 6 is a side elevational view of the knee brace of Figure 5 wherein the knee joint is in a flexed position, and

Figure 7 is a front elevational view of the knee brace of Figure 5.

Referring initially to Figure 1, an orthopaedic brace of the present invention is shown and generally designated 10. Although the brace as shown is adapted for mounting on the left leg of a user about the knee joint in support thereof, it is understood that the brace of the present invention has general utility for mounting on the limbs of the body about any joint that pivots in a single plane of motion, including the knee,

elbow and wrist. As is readily apparent to the skilled artisan, the brace configuration shown in Figure 1 requires only slight modification for adaptation to any such joint.

Brace 10 comprises a plurality of compliant support components including a shell 12, a lateral support strap 14, and a medial support strap 16. The compliant shell 12 has a distal portion 18 conformable to the upper leg. The distal portion 18 is preferably formed from a single continuous shaped piece of a stiffened sheet material that is resiliently bendable, ie. elastic, in the vertical plane to readily conform to the body contours of the user, but is substantially unstretchable, ie. inelastic, in the horizontal plane to provide a secure anchor for support straps 14, 16, as will be described hereafter. Materials which satisfy these criteria include certain plastics, fibreglass, and like compositions as are readily known to one skilled in the art.

The integral elements of distal portion 18 include a distal (or calf) cuff 22, having a lateral distal arm 24 and medial distal arm 26 extending proximally therefrom. The proximal portion 20 is likewise preferably formed from a single continuous shaped piece of a stiffened sheet material having the same characteristics as distal portion 18. The integral elements of proximal portion 20 include a proximal (or thigh) cuff 28, having a lateral proximal arm 30 and medial proximal arm 32 extending distally therefrom.

Lateral distal arm 24 is pivotally connected to lateral proximal arm 30 and medial distal arm 26 is pivotally connected to medial proximal arm 32 across a hinge means comprising a lateral pin 34 and a medial pin 36 (shown in Figure 2), respectively. Pins 34, 36 are preferably rivets rotatably fastening arm 24 to arm 30 and arm 26 to arm 32, respectively.

Support straps 14, 16 are formed from a wear-resistant supple material such as pliant leather, or preferably natural or synthetic cloth, including nylon and the like, which is compliant, but substantially unstretchable. Both support straps 14, 16 are connected to shell 12 by fixably engaging shell 12 at a proximal engagement point 38 substantially centrally located on the proximal cuff 28. Fixable engagement of the support straps 14, 16 and proximal cuff 28 is secured by a rivet 40 extending therethrough. Referring to Figure 2 in conjunction with Figure 1, support straps 14, 16 are further shown connected to shell 12 by fixably engaging shell 12 at a distal engagement point 42 substantially centrally located on the distal cuff 22. Fixable engagement of the support straps 14, 16 and distal cuff 22 is secured by a rivet 44 extending therethrough.

Support straps 14, 16 can be formed from two separate lengths of strap having ends that are connected at engagement points 38 and 42 by rivets 40 and 44, respectively. Alternatively, support straps 14, 16 can be formed from a single length of strap that is

continuous at engagement point 38 or 42, but having two free ends that are connected at the opposite engagement point 38 or 42 by rivet 40 or 44, respectively.

In either case, adjustment of the length of support straps 14, 16 is provided, as shown in Figure 2, by including adjustment loops 46, 48 and hook and loop fasteners 50, 52, commonly termed **VELCRO** fasteners, along the length of straps 14, 16. Strap 14 has an end 54 adjustably attached to loop 46 by threading end 54 through loop 46 and doubling end 54 back onto itself for fastening thereto by fastener 50. Strap 14 further has a fixed length portion 56 fixably attached to loop 46 which extends to rivet 44 at distal engagement point 42. Likewise, strap 16 has an end 58 adjustably attached to loop 48 and a fixed length portion 60 fixably attached to loop 48 and extending to rivet 44 in substantially the same manner as strap 14.

An alternate embodiment of the support strap and shell engagement means is shown on a brace generally designated 62 in Figure 3. The support straps 14, 16 of brace 62 are formed from a single length of strap that is continuous at the proximal engagement point 38 centrally located on the proximal cuff 28. The continuous length of strap is partitioned into the two support straps 14, 16 at the engagement point 38 by looping the strap through a pair of engagement slots 64a, 64b formed in cuff 28 which provide slidable engagement between the cuff 28 and the support straps 14, 16. Although not shown in Figure 3, the two free ends of the length of strap are fixably connected at the distal engagement point by a rivet through the strap ends and distal cuff 22 in the same manner as shown in Figure 2 and described above.

It is understood that the proximal position of slots 64a, 64b can be reversed with the distal position of the rivet in brace 62 such that slots 64a, 64b are formed in the distal cuff 22 and the rivet is placed in the proximal cuff 28 to achieve essentially the same objective. In substantially all other respects, brace 62 is identical to brace 10. Accordingly, it is noted that loops 48 are provided in the same manner as brace 10 (only one loop 48 is shown here on lateral distal arm 24) to enable adjustment of support straps 14, 16.

Referring to both the embodiment of Figures 1 and 2 and the embodiment of Figure 3, it is shown that the lateral support strap 14, extends laterally from the proximal engagement point 38 across an opening 68 in shell 12 framed by arms 24, 26, 30, 32 to the distal engagement point 42. Conversely, the medial support strap 16 extends medially from the proximal engagement point 38 across opening 68 to the distal engagement point 42.

Braces 10 and 62 are further provided with a plurality of proximal shell retention straps 70a, 70b and a plurality of distal shell retention straps 72a, 72b, 72c

which are in engagement with the shell 12 by threading them through proximal retention slots 74a, 74b and distal retention slots 76a, 76b, 76c, respectively. In a preferred configuration, distal shell retention strap 72c is positioned on the opposite side of shell 12 from distal shell retention straps 72a, 72b. However, it is understood that other retention strap configurations are possible within the scope of the present invention.

Retention straps 70a, 70b, 72a, 72b, 72c enable closure of brace 10 or 62 around the limb on which the brace is mounted. Each retention strap 70a, 70b, 72a, 72b, 72c is integrally provided with a hook and loop fastener 78 at the ends thereof to enable release of the retention strap or adjustment to the length of the retention strap for close conformance of the shell 12 to the limb on which the brace is mounted.

A lateral guide strap 80 having two ends is fixably attached at its one end by means such as stitching to lateral support strap 14. A medial guide strap 82 having two ends is similarly attached at its one end to medial support to strap 16. Guide straps 80 and 82 extend laterally and medially, respectively, to a retention member that is shown herein to be a distal shell retention strap 72b. The opposite ends of both guide straps 80 and 82 are fixably attached to the distal shell retention strap 72b by means such as stitching. Guide straps 80, 82 and retention straps 70a, 70b, 72a, 72b, 72c are formed from a supple material, such as natural or synthetic cloth, having substantially the same characteristics as the material of support straps 14, 16 although the material of guide straps 80, 82 can be elastic to enable stretching thereof.

A distal retention strap pad 84 is attached to the inside of distal shell retention straps 72a, 72b by means such as stitching. Pad 84 covers substantially the entire opening 86 of shell 12 opposite distal cuff 22 to more uniformly distribute the load of distal shell retention straps 72a, 72b across the underlying limb for the comfort of the user. Pad 84 is preferably covered with a soft cloth, such as felt or the like, enclosing a foam cushion.

The preferred relationship between the distal retention strap pad 84, distal shell retention straps 72a, 72b, lateral and medial guide straps 80, 82, and the distal portion 18 of shell 12 is shown in greater clarity with reference to Figure 4. As recited above, distal shell retention strap 72b serves as a retention member for the attachment of guide straps 80, 82 thereto, thus enabling the connection of guide straps 80, 82 to shell 12 thereacross. In an alternate configuration (not shown), however, it is apparent that the distal retention strap pad 84 can serve as the retention member for the attachment of guide straps 80, 82 thereto, effectuating the connection of guide straps 80, 82 to shell 12.

It is further noted with reference to Figures 1-4 that the distal portion 18 and proximal portion 20 of

shell 12 are fitted with distal and proximal shell pads 88, 90, respectively. Shell pads 88, 90 are shaped in substantial conformance with the outline of the distal and proximal portions 18, 20. Shell pads 88, 90 enable a close fit of the brace 10 or 62 on the limb of a user and cushion the user from the stiffened inner surface of the shell 12. Pads 88, 90 are constructed from a cloth-covered foam material and are removably attached to the inner surface of the shell 12 by means of a plurality of hook and loop fasteners not shown.

Although braces 10 and 62 have been shown in Figures 1-3 and described above as having the distal and proximal cuffs 22, 28 positioned on opposite sides of brace 10 or 62, it is within the scope of the present invention to position the distal and proximal cuffs 22, 28 on the same side of brace 10 or 62, either anteriorly or posteriorly. In these embodiments, the support straps 14, 16 are, nevertheless, connected to the distal and proximal cuffs 22, 28, although connection to one of cuffs 22 or 28 is indirect, while connection to the remaining cuff is direct.

As defined herein an indirect connection is one wherein the support strap 14 or 16 is interveningly attached to a retention member, such as retention strap or retention strap pad, which in turn is attached to a cuff 22 or 28. A direct connection is one wherein the support strap 14 or 16 is attached directly to cuff 22 or 28 without attachment to any intervening members. Thus, in these embodiments, one of the engagement points for the support straps 14, 16 is on a retention member and the other engagement point remains on cuff 22 or 28.

Referring to Figures 5-7, brace 10 is shown in use mounted on the leg 92 of a user. In the preferred configuration of brace 10, the proximal cuff 28 is positioned on the anterior of the leg 92 against the thigh of the upper leg 94 while the distal cuff 22 is positioned on the posterior of the leg 92 against the calf of the lower leg 96. It is understood by the skilled artisan, however, that these positions can be reversed with the proximal cuff posteriorly positioned and the distal cuff anteriorly positioned. Cuffs 28, 22, being preferably formed from sheet material, are fully conformable to the leg 92 and have a relatively smooth even broad outer surface that is substantially free of protrusions and flush with the outer surface of the leg 92 to minimise interference from the brace 10 during use thereof, and particularly during use in athletic activities, such as soccer.

Lateral and medial proximal arms 30, 32 distally extend from the proximal cuff 28 in correspondence to the longitudinal axis of the upper leg 94. Similarly, the lateral and medial distal arms 24, 26 proximally extend from the distal cuff 22 in correspondence to the longitudinal axis of the lower leg 96. Arms 24, 26, 30, 32 define the opening 68 on the anterior of brace 10 which receives the patella 98. Lateral and medial

support straps 14, 16 pass diagonally along opposite sides of the patella 98 and lateral and medial guide straps 80, 82 likewise pass diagonally along opposite sides of the patella 98.

It is noted that when the brace of the present invention is adapted for use with other applicable joints of the body, the opening framed by the arms is generally positioned on the side of the brace opposite the direction of joint flexion to receive the skeletal protrusion of the joint being supported. The support straps and guide straps are generally positioned to extend around the perimeter of the opening, framing the skeletal protrusion therein.

Brace 10, as shown in Figures 5-7, is configured to function as a four-point brace in the manner disclosed by US Patent 4,697,583, which is incorporated herein by reference. The four points of brace 10 which supply counteractive support forces to the leg 92 are proximal cuff 28, proximal shell retention strap 70b, distal cuff 22, and distal shell retention strap 72b.

When applied to support of the knee joint, brace 10 is specifically applicable to support of the medial collateral ligament (MCL), to support of the lateral collateral ligament (LCL), or to support of both the MCL and LCL simultaneously. In support of the MCL, the lateral support strap 14 receives outwardly directed loads applied to the medial side of the knee joint and effectively prevents valgus rotation of the knee joint up to the preload limit of the brace 10, thereby reducing the load on the MCL. In this mode, the primary support function of the brace 10 is borne by the lateral support strap 14 while the medial support strap 16 provides a resisting moment to maintain the position of the brace 10 relative to the leg 92 and prevent rotation of proximal cuff 28 axially about the leg 92 relative to distal cuff 22.

In support of the LCL, the medial support strap 16 receives inwardly directed loads applied to the lateral side of the knee joint up to the preload limit of the brace 10, thereby reducing the load on the LCL. In this mode, the primary support function of the brace 10 is borne by the medial support strap 16 while the lateral support strap 14 provides a resisting moment to maintain the position of the brace 10 relative to the leg 92 and prevent rotation of distal cuff 22 axially about the leg 92 relative to proximal cuff 28.

The preload limit of the brace 10 is a function of the length, and correspondingly the tension, of support straps 14, 16, which are adjustable according to the manner described above. In general, it is desirable to set the tension of the support straps 14, 16 to a maximum preload limit defined by the comfort threshold of the user because, if the load on brace 10 exceeds the preload limit of the brace 10, the brace 10 will begin to yield, enabling valgus or varus rotation of the joint.

It is noted that the preload limit of the brace 10 is greater than the preload limit of the support straps 14,

16 to a maximum preload limit defined by the comfort threshold of the user because, if the load on brace 10 exceeds the preload limit of the brace 10, the brace 10 will begin to yield, enabling valgus or varus rotation of the joint.

It is noted that the preload limit of the brace 10 is greater than the preload limit of the support straps 14, 16 alone because when the load on support straps 14, 16, the load is transferred to shell 12. The combination of support components, specifically shell 12 and support straps 14, 16, effectively resists valgus or varus rotation of the joint due to the relative positions and geometry of the components about the joint, and further, due to the continued action of the support straps 14, 16 to prevent rotation of the distal cuff 22 relative to the proximal cuff 28 axially about the limb.

As is apparent, the efficacy of the brace 10 derives from the ability of the support straps 14, 16 to prevent valgus rotation of the joint, thereby protecting the MCL, when a medial load is applied to the associated limb and/or to prevent varus rotation of the joint, thereby protecting the LCL, when a lateral load is applied to the associated limb. In particular, if a lateral load is applied to the limb, the load is translated to tension on the medial support strap 16 and compression on the lateral arms 24, 30. The lateral load is further translated to tension on the lateral support strap 14 which serves to prevent axial rotation of cuffs 22, 28 due to the tension on medial support strap 16.

Conversely, if a medial load is applied to the limb, the load translates to tension on the lateral support strap 14 and compression on the medial arms 26, 32. The medial load is further translated to tension on the medial support strap 16 which serves to prevent axial rotation of cuffs 22, 28 due to the tension on lateral support strap 14.

From the description set forth above, it is apparent to the skilled artisan that, although the brace of the present invention utilises compliant support components, the brace, nevertheless, achieves the desired effect of stabilising the joint by providing control and stability thereto. This effect results from the specific orientation of the compliant support components relative to each other and to the limb on which the brace is mounted, as taught herein, which enables the compliant support components in combination to resist valgus or varus rotation of the joint.

While the forgoing preferred embodiments of the invention have been described and shown, it is understood that alternatives and modifications, such as those suggested and others, may be made thereto and fall within the scope of the invention.

## Claims

1. An orthopaedic brace substantially free of any rigid support components mountable on a leg for supporting a knee joint between the upper and lower leg, said brace comprising:
  - a) a compliant shell comprising,
    - 1) an upper leg cuff conformingly positionable on the upper leg, and
    - 2) a lower leg cuff conformingly positionable on the lower leg;
  - b) hinge means pivotally engaging said shell for rotating said upper leg cuff relative to said lower leg cuff about the knee joint; and
  - c) a support strap engaging said brace at at least two engagement points, wherein a first engagement point on said brace is adjacent to the upper leg on a first side of the leg and a second engagement point on said brace is adjacent to the lower leg on a second side of the leg opposite the first side of the leg, such that said support strap extends laterally or medially from the first side of the upper leg across the knee joint to the second side of the lower leg.
2. The orthopaedic brace of claim 1 wherein said first engagement point is on said upper leg cuff and said second engagement point is on said lower leg cuff.
3. The orthopaedic brace of claim 1 further comprising a second support strap medially extending from the first side of the upper leg across the knee joint to the second side of the lower leg.
4. The orthopaedic brace of claim 3 further comprising a second support strap engaging said brace at said at least two engagement points, such that said second support strap extends laterally from the first side of the upper leg across the knee joint to the second side of the lower leg.
5. The orthopaedic brace of claim 1 wherein said support strap is a first support strap laterally extending from the first side of the upper leg across the knee joint to the second side of the lower leg.
6. The orthopaedic brace of claim 5 further comprising a second support strap engaging said brace at said at least two engagement points, such that said second support strap extends medially from the first side of the upper leg across the knee joint to the second side of the lower leg.
7. The orthopaedic brace of claim 1 wherein the first side of the upper leg is the anterior of the leg and the second side of the lower leg is the posterior of the leg such that said support strap extends from the anterior of the upper leg to the posterior of the lower leg.
8. The orthopaedic brace of claim 1 further comprising a guide strap having a first end attached to said support strap and a second end connected to said shell.
9. The orthopaedic brace of claim 1 wherein said shell further comprises,
  - a lateral upper leg arm and a medial upper leg arm, said upper leg arms connected to said upper leg cuff and extending distally therefrom generally longitudinal to the thigh, and
  - a lateral lower leg arm and a medial lower leg arm, said lower leg arms connected to said lower leg cuff and extending proximally therefrom generally longitudinal to the calf.
10. The orthopaedic brace of claim 9 wherein said hinge means comprise a first pin adjacent to the knee joint pivotally connecting said lateral upper leg arm to said lateral lower leg arm and a second pin adjacent to the knee joint pivotally connecting said medial upper leg arm to said medial lower leg arm.
11. An orthopaedic brace substantially free of any rigid support components mountable on a limb for supporting a joint between the proximal and distal portions of the limb, said orthopaedic brace comprising:
  - a) a compliant shell comprising,
    - 1) a proximal cuff conformingly positionable on the proximal portion of the limb;
    - 2) a distal cuff conformingly positionable on the distal portion of the limb;
  - b) hinge means pivotally engaging said shell for rotating said proximal cuff relative to said distal cuff about the joint; and
  - c) a support strap engaging said brace at at least two engagement points, wherein a first engagement point on said brace is adjacent to the proximal portion of the limb on a first side of the limb and a second engagement point on said brace is adjacent to the distal portion of the limb on a second side of the limb opposite the first side of the limb, such that said support strap extends laterally or medially from the first side of the limb across the joint to the second side of the limb.
12. The orthopaedic brace of claim 11 wherein said first engagement point is on said proximal cuff and said second engagement point is on said distal cuff.

13. The orthopaedic brace of claim 11 wherein said support strap is a first support strap medially extending from the first side of the proximal portion of the limb across the joint to the second side of the distal portion of the limb.

14. The orthopaedic brace of claim 13 further comprising a second support strap engaging said brace at said at least two engagement points, such that said second support strap extends laterally from the first side of the proximal portion of the limb across the joint to the second side of the distal portion of the limb.

15. The orthopaedic brace of claim 11 wherein said support strap is a first support strap laterally extending from the first side of the proximal portion of the limb across the joint to the second side of the distal portion of the limb.

16. The orthopaedic brace of claim 15 further comprising a second support strap engaging said brace at said at least two engagement points, such that second support strap extends medially from the first side of the proximal portion of the limb across the joint to the second side of the distal portion of the limb.

17. An orthopaedic brace substantially free of any rigid support components mountable on a leg for supporting a knee joint between the upper and lower leg, said brace comprising:

- a) a compliant shell comprising,
  - 1) an upper leg cuff conformingly positionable on the anterior of the upper leg, and
  - 2) a lower leg cuff conformingly positionable on the posterior of the lower leg;
- b) hinge means pivotally engaging said shell for rotating said upper leg cuff relative to said lower leg cuff about the knee joint;
- c) a first support strap engaging said shell at at least two engagement points, wherein a first engagement point is on said upper leg cuff and a second engagement point is on said lower leg cuff, such that said support strap extends laterally from the anterior of the upper leg across the knee joint to the posterior of the lower leg; and
- d) a second support strap engaging said shell at said at least two engagement points, such that said second support strap extends medially from the anterior of the upper leg across the knee joint to the posterior of the lower leg.

18. The orthopaedic brace of claim 17 further comprising a first guide strap having a first end attached to said first support strap and a second end connected to said shell and a second guide

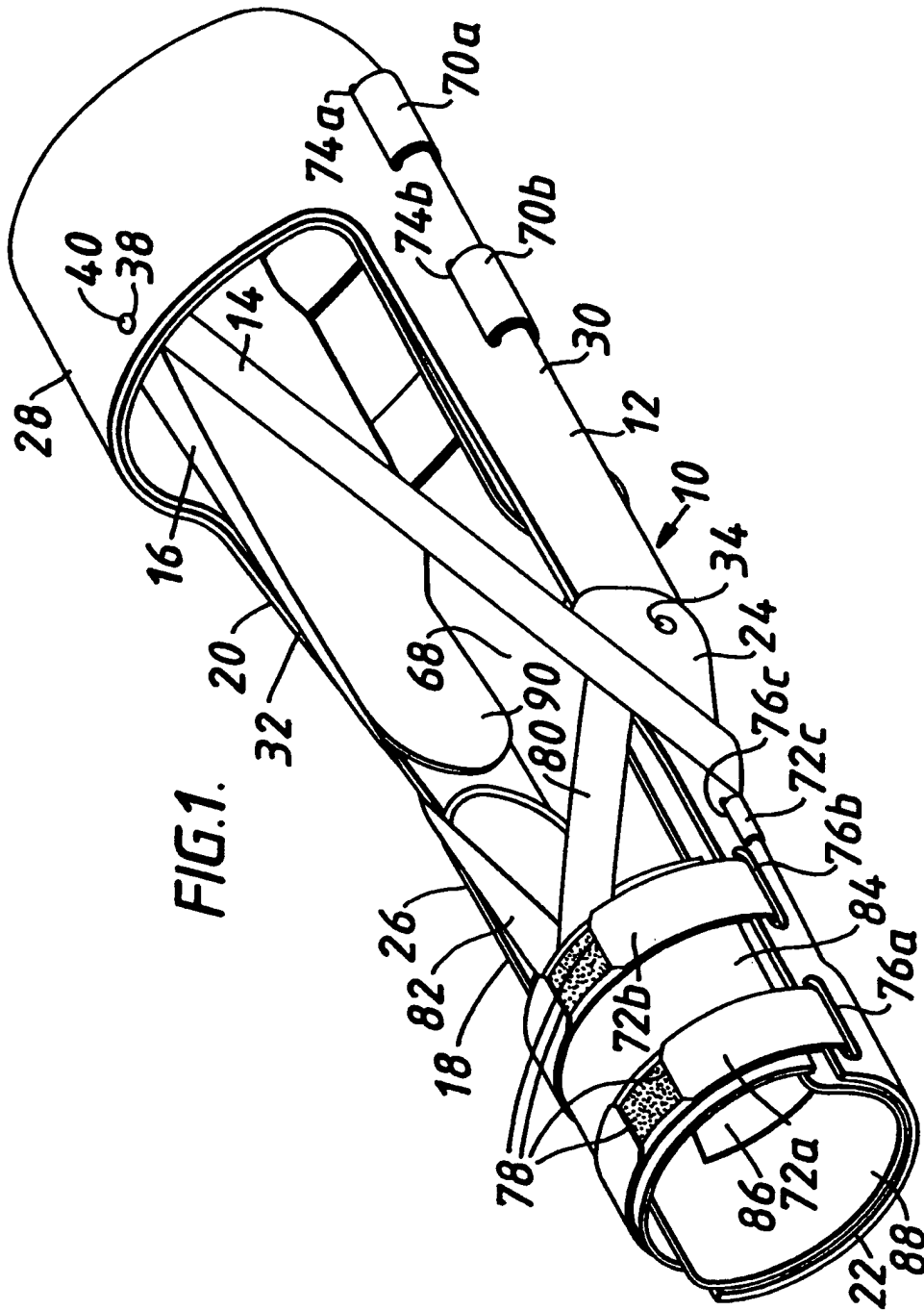
strap having a first end attached to said second support strap and a second end connected to said shell.

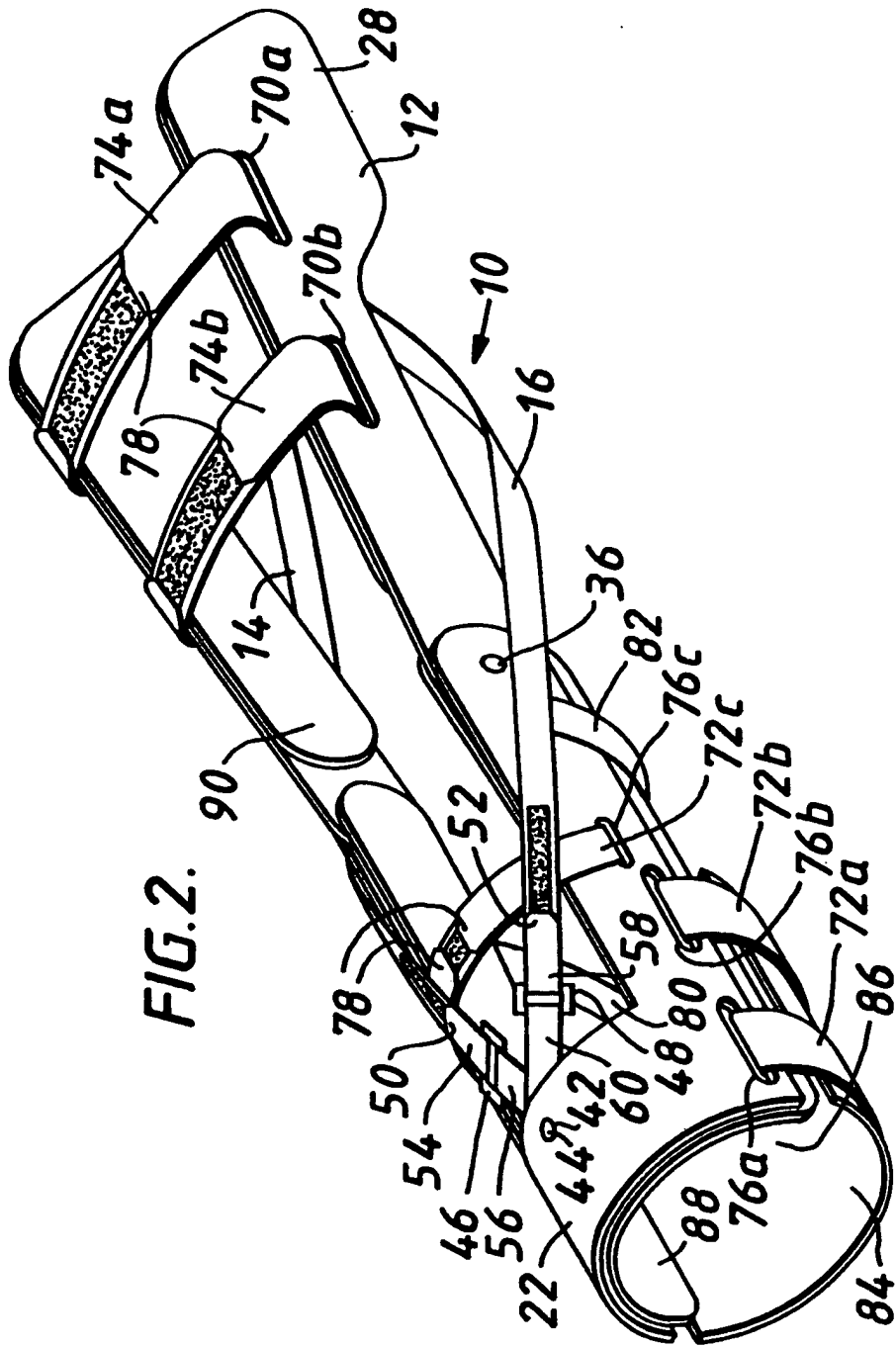
5 19. The orthopaedic brace of claim 17 wherein said shell further comprises,

a lateral upper leg arm and a medial upper leg arm, said upper leg arms connected to said upper leg cuff and extending distally therefrom generally longitudinal to the thigh, and

a lateral lower leg arm and a medial lower leg arm, said lower leg arms connected to said lower leg cuff and extending proximally therefrom generally longitudinal to the calf.







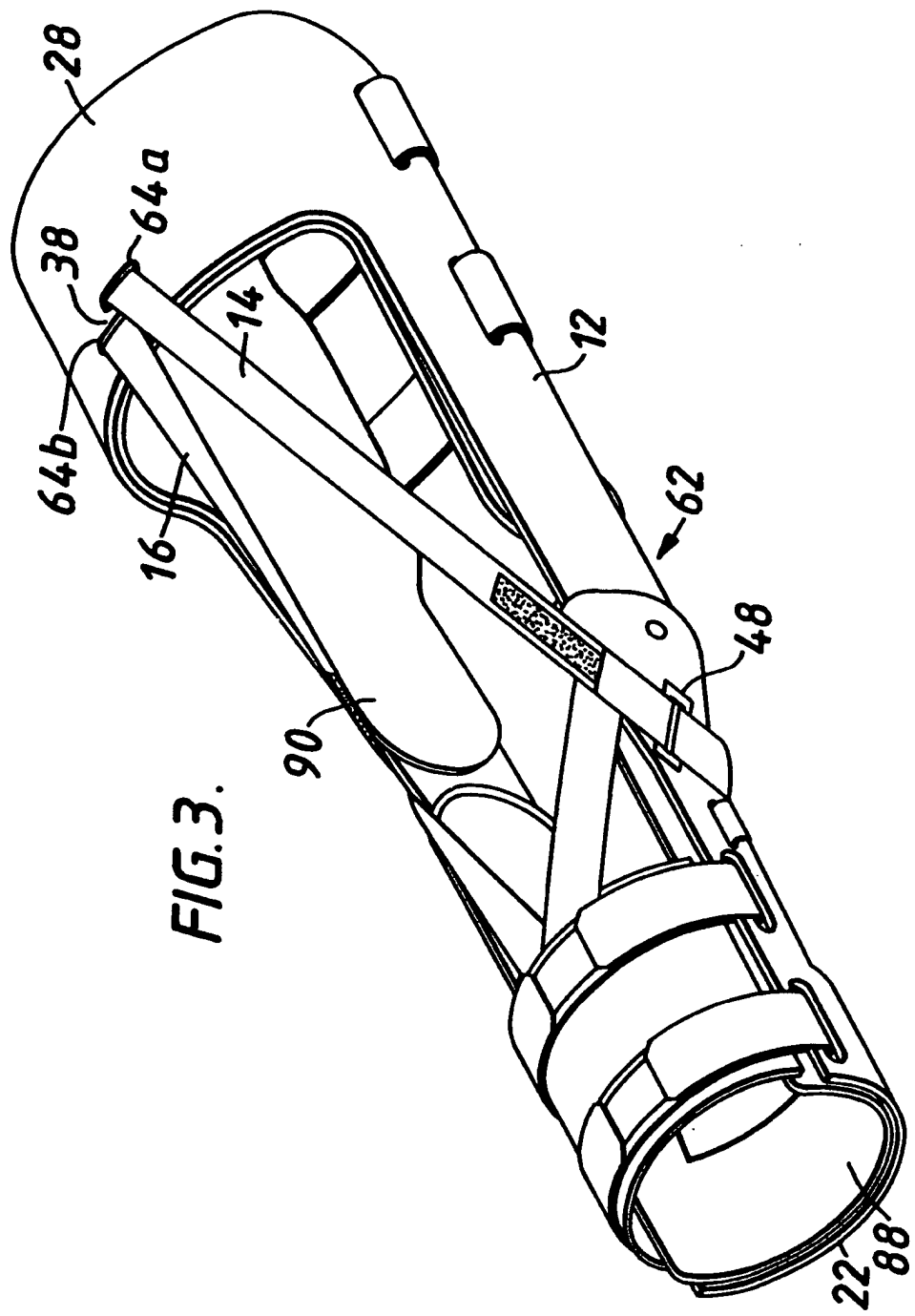


FIG. 4.

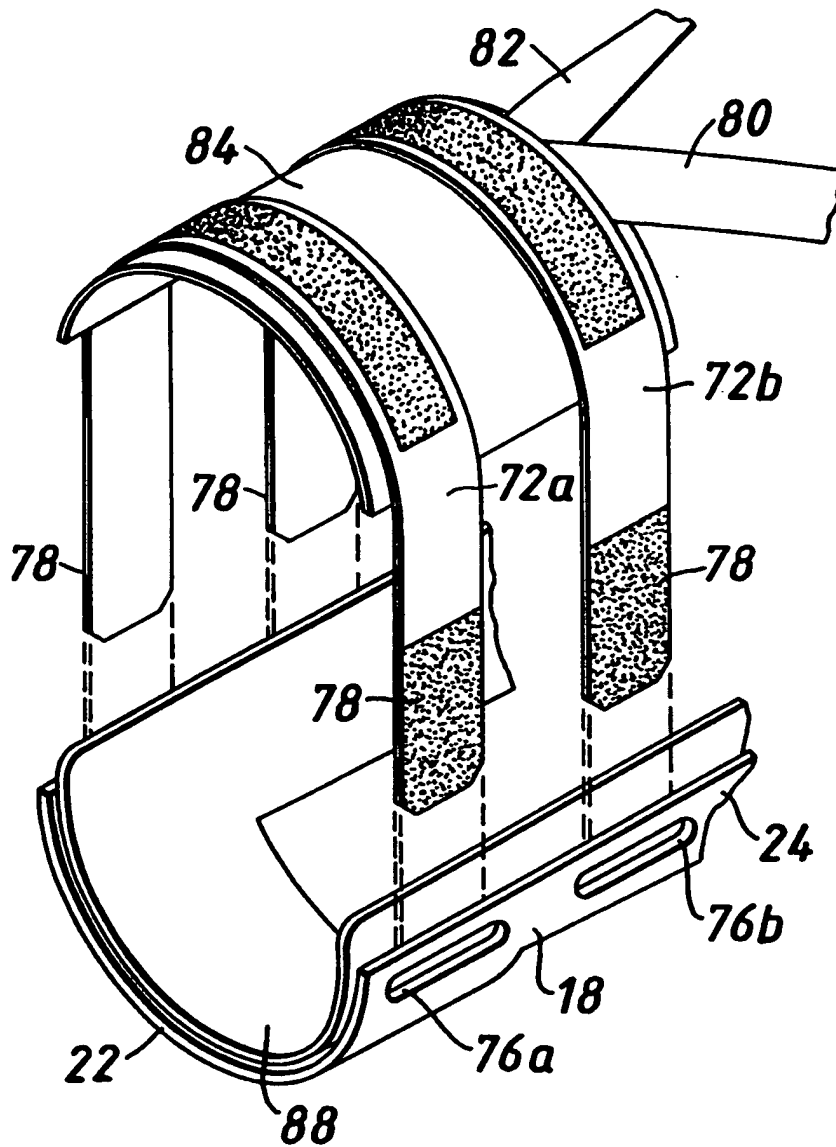


FIG. 5.

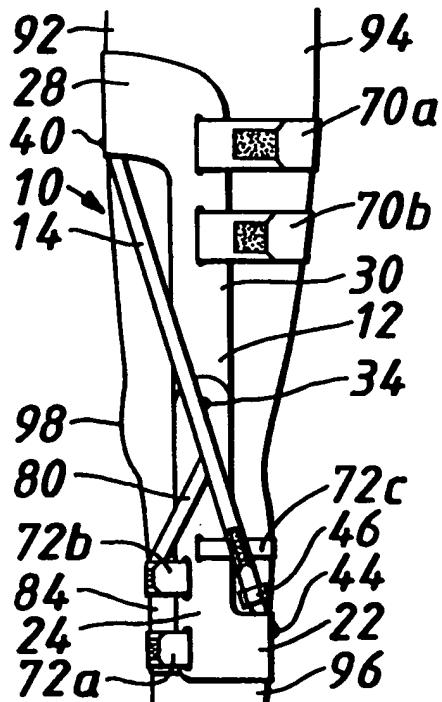


FIG. 7.

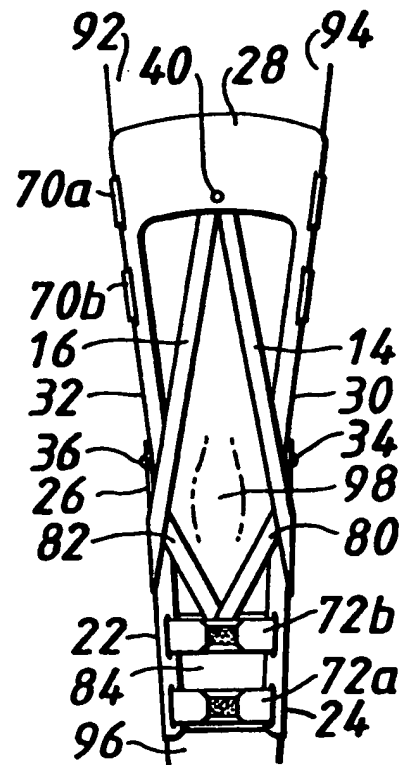
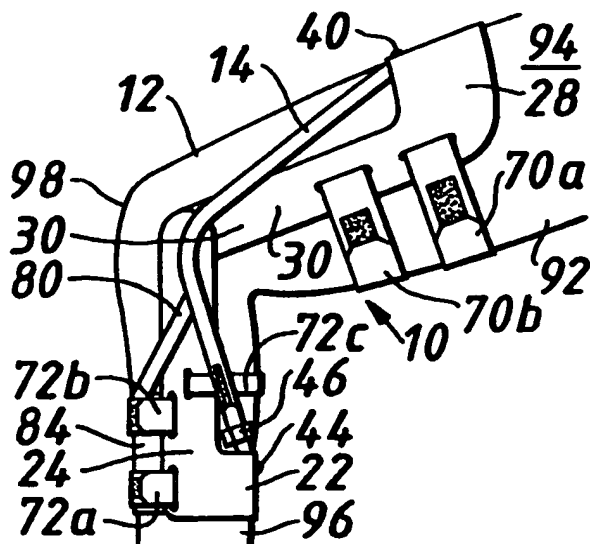


FIG. 6.





European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 94 30 0613

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. CLS)
X	AU-A-521 722 (VANSMAALEN ET AL)	1-7, 9, 10, 17-19	A61F5/01
Y	* page 3, line 22 - page 5, line 19; claims 1-6; figures *	11-16	
Y	FR-A-2 627 381 (PROTEOR) * abstract; figures *	11-16	
X	DE-B-10 24 204 (FEIERABEND) * column 2, line 43 - column 4, line 4; figures *	1, 8	
X, D	US-A-5 063 916 (FRANCE ET AL.) * abstract; figure 4 *	1, 2	
A	DE-A-40 13 693 (EISENBERG)		
A	US-A-4 506 661 (FOSTER)		
A	US-A-3 669 105 (CASTIGLIA)		
			TECHNICAL FIELDS SEARCHED (Int. CLS)
			A61F
The present search report has been drawn up for all claims			
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>19 April 1994</b>	Examiner <b>Sánchez y Sánchez, J</b>
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure F : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 (01/92) (P04C01)